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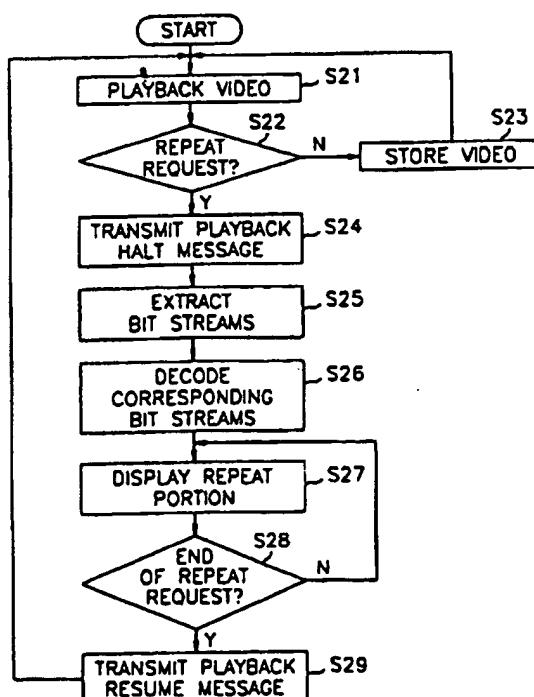
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(54) Abstract Title  
Repetitive video replay in video on demand system

(57) Playback of a video in response to a user's command is carried out and a predetermined amount of a latest portion of the bit stream is stored in a FIFO memory during the playback of the video 523. If a user enters a command for repetitive replay of a latest portion of the video playback of the video is halted 524 and a repetition interval and the number of repetitions are detected for repetitive replay of the latest portion of the video from the FIFO memory 527. Thereafter, playback of the video is resumed 529.

FIG. 2



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*FIG. 1*

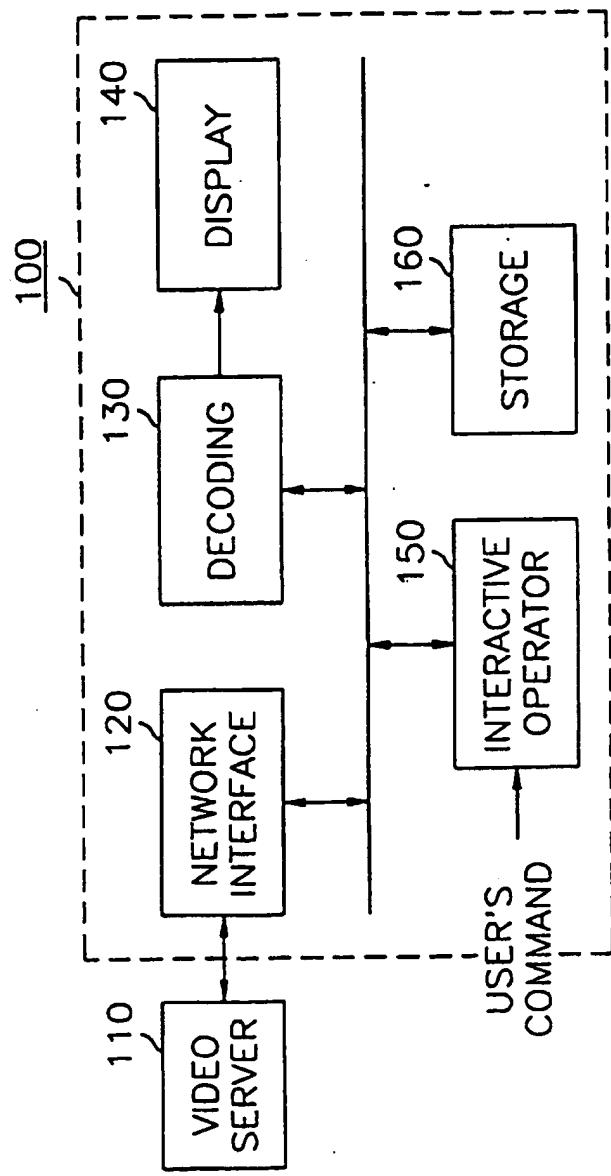


FIG.2

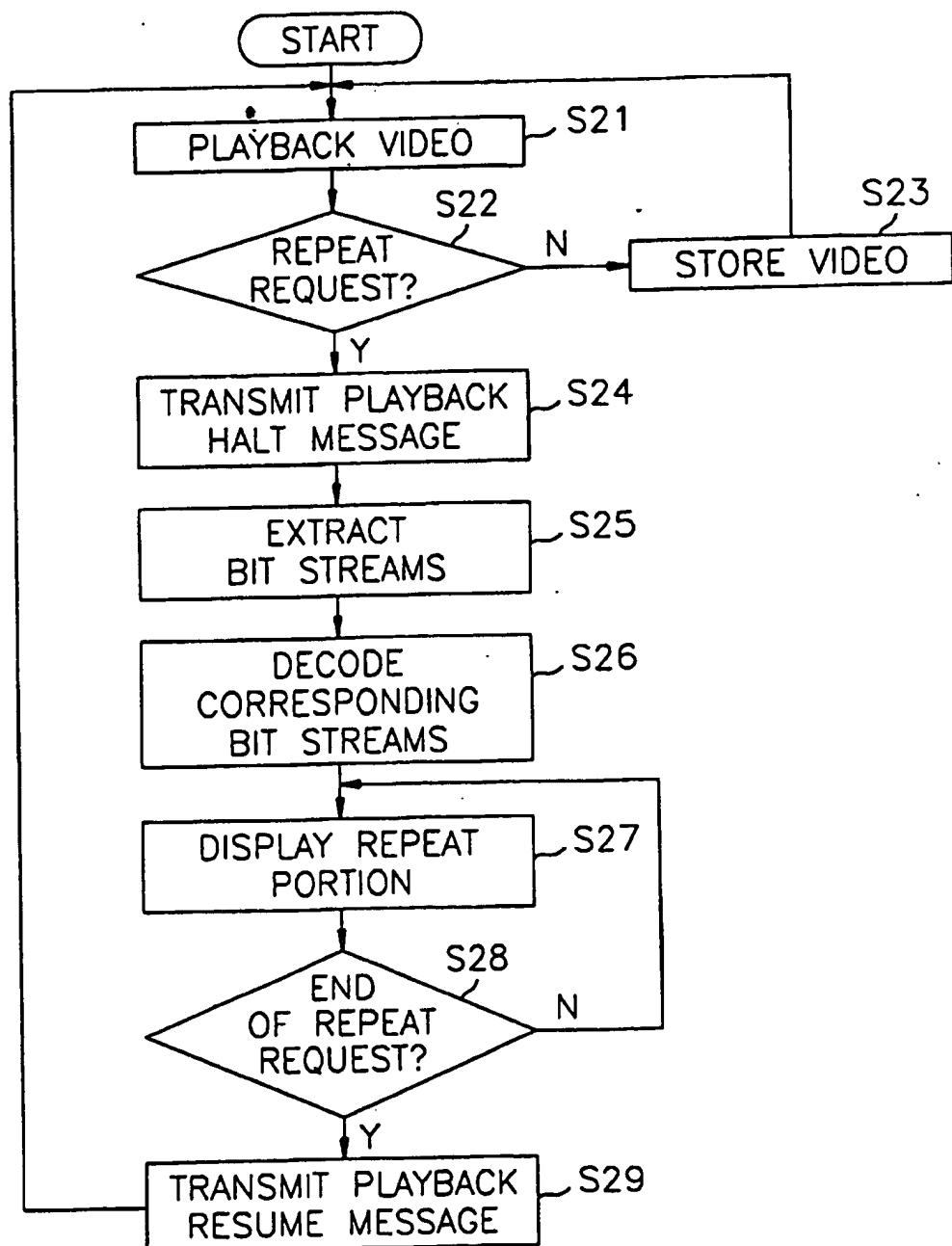


FIG. 3A

1	B	B	P	B	B	P	B	B	P			
0	1	2	3	4	5	6	7	8	9	10	11	12

FIG. 3B

1	P	B	B	P	B	B	P	B	B	P	B	B
0	3	1	2	6	4	5	9	7	8	12	10	11

REPETITIVE VIDEO REPLAY METHOD AND APPARATUS  
FOR USE IN A VIDEO ON DEMAND SYSTEM

5       The present invention relates to a method and apparatus  
for use in a video on demand system; and, more particularly,  
to a method and apparatus for use in a video on demand system  
capable of repetitively replaying a latest portion of a video  
without retrieving corresponding bit streams from a video  
10      server.

As the so-called information superhighway is being developed, a wide bandwidth communication channel which interconnects households and businesses promises to provide many services to those connected to it. These services may include banking at home, instant access to large databases and real time interaction with virtual communities of people with similar interests. Of the services that the superhighway may make available, one that has received a great deal of corporate and media attention is the supply of video on demand ("VOD").

Desirable VOD services can include such videos as movies, sporting events, interactive games, home shopping, textual information, educational programs and arts programs. Videos generally include both video and audio portions, although a

video may only have an image portion as in textual information, or only an audio portion as ,e.g., music.

Users would like to have videos of their choice to be available at times and locations convenient for them. It  
5 would be advantageous if the videos could be delivered by any transmission media, such as commercial telephone, cable and satellite networks. The videos should be compatible with readily available display systems, such as standard televisions or personal computers.

10 Furthermore, users would like to have real time, interactive VCR-like control of the videos, e.g., skipping, holding, or replaying portions at will. In a conventional VOD system, if a user requests to replay a portion that has been played before, a set top unit transmits a replay request  
15 message including frame address information indicating the portion to be replayed to a video server. The video server, in response to the replay request message, retrieves bit streams corresponding to the frame address and transmits the bit streams to the set top unit.

20 When a user wants to repetitively replay a latest portion of a video that has been played just before, e.g., an English conversation practice program, taking all the above steps to retrieve bit streams of only a few seconds places enormous demands on the system's storage units, internal buses and processing units, thereby increasing the processing time  
25 unnecessarily and utilizing the network resources

inefficiently.

It is, therefore, a primary object of the invention to  
5 provide a method and apparatus for use in a video on demand  
system capable of repetitively replaying a latest portion of  
a video without retrieving corresponding bit streams from a  
video server.

In accordance with one aspect of the present invention,  
10 there is provided a repetitive video replay method for use in  
a video on demand system, comprising the steps of: (a) carrying out playback of a video in response to a user's command for playback of the video; (b) storing constantly a predetermined amount of a latest portion of bit streams in a  
15 FIFO memory during the playback of the video; (c) checking if a user's command for repetitive replay of a latest portion of the video is inputted during the playback of the video; (d) halting playback of the video if the checked result at the step (c) is affirmative; (e) detecting a repetition interval and the number of repetitions from the user's command for  
20 repetitive replay of the latest portion of the video; (f) replaying the stored bit streams corresponding to the repetition interval as many times as the number of repetition; (g) resuming playback of the video; and (h) repeating steps  
25 (b) to (g) until the video ends.

In accordance with another aspect of the present

invention, there is provided a repetitive video replay apparatus for use in a video on demand system, comprising:  
means for providing bit streams of a video in response to a playback request message, halting to provide the bit streams  
5 of the video in response to a playback halt message and resuming to provide the bit streams of the video in response to a playback resume message; means for constantly storing a predetermined amount of a latest portion of the bit streams during the playback of the video; means for decoding the bit  
10 streams from the bit streams providing means in response to a user's command for playback of the video and decoding the bit streams stored in the storing means in response to a user's command for repetitive replay of the latest portion of the video; means for displaying the bit streams decoded at the decoding means; means for providing the playback request message to the bit streams providing means in response to the user's command for playback of the video, the playback halt message to the bit streams providing means in response to the user's command for repetitive replay of the latest portion of  
15 the video and playback resume message to the bit streams providing means when repetition of the latest portion of the video ends; and means for providing interface between the bit streams providing means and the other means of the repetitive video replay apparatus except for the bit streams providing means.  
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The above and other objects and features of the present invention will become apparent from the following description of preferred embodiments given in conjunction with the accompanying drawings, in which:

5 Fig. 1 represents a block diagram of the repetitive video playback apparatus in accordance with the present invention;

Fig. 2 provides a flow chart of the repetitive video playback method in accordance with the present invention;

10 Fig. 3A presents an exemplary sequence of pictures in a group of pictures in a display order; and

Fig. 3B shows an exemplary sequence of pictures in a group of pictures in a bit stream order.

15 Referring to Fig. 1, there is provided a block diagram of a repetitive video replay apparatus 100 for use in a video on demand system in accordance with a preferred embodiment of the present invention. The repetitive video replay apparatus 100 comprises a network interface unit 120, a decoding unit 130, a display unit 140, an interactive operator 150 and a storage unit 160, and communicates with a video server 110 through a communication network.

20 The video server 110 is a conventional video server which transfers bit streams corresponding to a video requested by a user in response to a playback request message from the 25 interactive operator 150 through the network interface unit

120 and halts to transfer the bit streams in response to a playback halt message from the interactive operator 150 through the network interface unit 120.

The network interface unit 120 includes, for example, a communication modem, and provides an interface of various kinds of messages or data between the repetitive video replay apparatus 100 and the video server 110.

The decoding unit 130 receives bit streams which have been encoded and compressed after the MPEG(Motion Picture Expert Group) standard and decodes the bit streams. The encoded bit streams are transferred from the video server 110 through the network interface unit 120 in case of a conventional playback mode; and from the storage unit 160 in case of a repetitive replay mode.

The display unit 140 receives the decoded bit streams from the decoding unit 130 and carries out signal processings, e.g., digital to analog conversion, noise compensation and the like for the decoded bit streams to thereby deliver an image to the user.

The interactive operator 150 includes a micro processor for overall control of the repetitive video playback apparatus 100. When the user enters a command for the conventional playback mode, the interactive operator 150 provides the playback request message to the video server 110 through the network interface unit 120. While the bit streams of the requested video are received from the video server 110, the

interactive operator 150 stores the bit streams into the storage unit 160.

Furthermore, when the user enters a command for the repetitive replay mode, i.e., replaying a latest portion of 5 the requested video that has been just played, the interactive operator 150 provides the playback halt message to the video server 110 through the network interface unit 120. And, the interactive operator 150 stop storing the bit streams into the storage unit 160 and retrieves the bit streams corresponding 10 to the latest portion to be replayed that is stored in the storage unit 160 to thereby provide them to the decoding unit 130. When the repetitive replay mode ends, the interactive operator 150 provides a playback resume message to the video server 110 through the network interface unit 120.

15 The storage unit 160 is a FIFO(First In First Out) memory for storing the bit streams corresponding to a predetermined time interval, wherein a running time of the stored bit streams in accordance with the preferred embodiment of the present invention is, for instance, about 10 seconds. If the 20 storage unit 160 becomes full of the bit streams from the video server 110, i.e., when the FIFO memory becomes full, a bit of the stored bit streams is pushed out and a next bit of the bit streams is stored in the storage unit 160, wherein the bit which is pushed out has been stored in the storing means 25 for a longer time than any other bit of the bit streams. In this way, latest bit streams of the predetermined time

interval are stored in the storage unit 160.

The detailed operation of each unit will be illustrated referring to Fig. 2, wherein a flow chart of repetitive video replay method in accordance with the preferred embodiment of 5 the present invention is provided therein.

A repetitive video replay procedure starts with step S21, wherein a video is played in response to a playback request message. Specifically, if a user wants to watch a video, the user enters a command demanding for the conventional playback 10 mode by means of an input device, e.g., a remote controller for communicating with the interactive operator 150. The interactive operator 150 receives the command; generates the playback request message; and provides the playback request message to the video server 110 through the network interface 15 unit 120.

The video server 110 transmits bit streams corresponding to the video requested by the user to the repetitive video replay apparatus 100 in response to the playback request message. The bit streams are simultaneously applied to the decoding unit 130 and the storage unit 160 through the network 20 interface unit 120. The decoding unit 130 decodes the received bit streams and the decoded bit streams are displayed on a viewing device, e.g., a monitor, a television.

While playing the video, the interactive operator 150 checks if a command demanding for the repetitive replay mode 25 is entered, at step S22. The command demanding for the

repetitive replay mode is generated by the user when the user wants to rewatch a latest portion of the video that has been played just before, wherein the command includes a time interval of the latest portion to be repeated and the number of repetition.

If the checked result is negative, the procedure goes to step S23, wherein the interactive operator 150 stores the bit streams into the storage unit 160 and continues back to step S21. The latest portion of the bit streams of a predetermined amount are always stored in the storage unit 160 since the storage unit 160 is a sort of FIFO memory and the capacity of the storage unit 160 is fixed. To be more specific, the storage means 160 pushes out a bit of the stored bit streams and stores a next bit of the bit streams when the FIFO memory becomes full, wherein the bit which is pushed out has been stored in the storing means for a longer time than any other bit of the bit streams.

And if the checked result is affirmative, the procedure goes to step S24, wherein the interactive operator 150 generates a playback halt message to the video server 110 through the network interface unit 120. The video server 110 halts to transfer the bit streams in response to the playback halt message.

Then the interactive operator extracts the bit streams stored in the storage unit 160 at step S25.

At step S26, the decoding unit 130 group start codes.

picture start codes of each group and picture coding type of each picture in a group by reading the bit streams from the storage unit 160 to thereby detect the number of pictures in the bit streams and the order of picture sequence, wherein

5 each of the group start codes indicates a beginning of a group having a plurality of pictures, each of the picture start codes indicates a beginning of a picture and each of the picture coding types represents a way in which a picture was coded. Referring to Figs. 3A and 3B, there are respectively

10 presented exemplary sequences of pictures in a group of pictures in display order and in bit stream order. A typical bit streams contain a mix of I-, P- and B-pictures. I-pictures are intra coded pictures which are coded without reference to any other pictures, P-pictures are predictive coded pictures which are coded using motion compensation from a previous I- or P-pictures and B-pictures are bidirectionally predictive coded pictures which are coded using motion compensation from a previous and a future I- or P-picture.

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Because of the picture dependencies, the bit stream order, i.e., the order in which pictures are transmitted, stored or retrieved is not same as the display order, but rather same as the order in which the decoding unit 130 decodes the bit streams. A typical sequence of pictures of a group of pictures in the display order might be as in Fig. 3A, whereas a sequence of pictures of the group of pictures in the bit stream order is as in Fig. 3B. Since the B-

pictures depend on the following I- or P-picture in the display order, the I- or P-picture must be transmitted and decoded before the dependent B-pictures.

Meanwhile, the interactive operator 150 detects the latest portion to be repeated by analyzing the command demanding for the repetitive replay mode and informs the decoder 130 how many pictures to be decoded how many times. Assume that the time interval of the latest portion to be repeated is 5 seconds, the number of repetition is 2, the number of pictures displayed in 1 second is 60 and the command demanding for the repetitive replay mode is inputted when a B-picture 5 of Fig. 3A is displayed, the decoding unit 130 decodes approximately 300 pictures starting from the B-picture 5 of Fig. 3A.

If the 300th picture from the B-picture 5 of Fig. 3A is not an I-picture, the decoding unit 130 finds an I-picture contained in a group of pictures containing the 300th picture from the B-picture 5 of Fig. 3A to thereby determine the I-picture as a first picture to be decoded. The decoding unit 130 decodes pictures from the first picture to be decoded to the B-picture 5 of Fig. 3A and provides the decoded bit streams corresponding to the pictures to the display unit 160. The display unit 160 receives the decoded bit streams and carries out signal processings for the decoded bit streams.

At step S27, the decoded bit streams which are signal-processed are displayed on a display device, e.g., a standard

television or a monitor of a personal computer.

After the latest portion to be repeated is replayed, it is examined if the latest portion is repeated as many times as the number of repetition, at step S28. If the examined 5 result is affirmative, the procedure goes to step S29, wherein the interactive operator 150 transmits a playback resume message to the video server 110 through the network interface unit 120 and goes back to step S21. And if the examined result is negative, the procedure goes back to step S27, 10 wherein same latest portion is displayed again.

In accordance with the present invention, the processing time is reduced and the network resource is efficiently utilized since latest bit streams of a predetermined time interval is stored in a memory and repetitively replayed 15 without retrieving a corresponding bit streams from a video server.

While the present invention has been described with respect to certain preferred embodiments only, other modifications and variations may be made without departing 20 from the scope of the present invention as set forth in the following claims.

Claims:

1. A repetitive video replay method for use in a video on demand system, comprising the steps of:

5 (a) carrying out playback of a video in response to a user's command for playback of the video;

(b) storing constantly a predetermined amount of a latest portion of bit streams in a FIFO memory during the playback of the video;

10 (c) checking if a user's command for repetitive replay of a latest portion of the video is inputted during the playback of the video;

(d) halting playback of the video if the checked result at the step (c) is affirmative;

15 (e) detecting a repetition interval and the number of repetitions from the user's command for repetitive replay of the latest portion of the video;

(f) replaying the stored bit streams corresponding to the repetition interval as many times as the number of repetitions requested;

(g) resuming playback of the video; and

(h) repeating steps (b) to (g) until the video ends.

2. The method as recited in claim 1, wherein the step (a) includes the steps of:

(a1) inputting the user's command for playback of the

video;

(a2) retrieving the bit streams corresponding to the video;

(a3) sequentially transmitting the retrieved bit streams;

5 (a4) decoding the sequentially transmitted bit streams; and

(a5) displaying the decoded bit streams of the video.

3. The method of claim 1 or claim 2, wherein the FIFO memory  
10 of the step (b) pushes out a bit of the stored bit streams and stores a next bit of the bit streams when the FIFO memory becomes full, the bit which is pushed out having been stored in the storing means for a longer time than any other bit of the bit streams.

15 4. The method of any preceding claim, wherein the repetition interval of the step (e) represents a time interval from the instance that the user's command for repetitive replay of the latest portion of the video is inputted.

20 5. The method of any preceding claim, wherein the repetition interval of the step (e) is smaller than or equal to a maximum time interval corresponding to the bit streams of the full capacity of the FIFO memory.

25 6. The method of any preceding claim, wherein the step (f)

includes the steps of:

(f1) inputting the user's command for repetitive replay of the latest portion of the video;

(f2) retrieving the stored bit streams;

5 (f3) decoding the bit streams corresponding to the repetition interval;

(f4) displaying the bit streams decoded at the step (f3);

and

10 (f5) repeating the step (f4) as many times as the number of repetitions less 1.

7. The method as recited in claim 6, wherein the decoding step (f3) contains the steps of:

15 (f31) examining group start codes, picture start codes of each group and picture coding type of each picture in a group by reading the retrieved bit streams of the step (f2), wherein each of the group start codes indicates a beginning of a group having a plurality of pictures, each of the picture start codes indicates a beginning of a picture and each of the picture coding types represents a way in which a picture was coded;

20 (f32) detecting a picture in the retrieved bit streams that is displayed at the instant that the user's command for repetitive replay of the latest portion of the video is inputted;

25 (f33) calculating the number N of pictures to be decoded,

wherein N is a positive integer proportional to the repetition interval;

(f34) searching an Nth picture from the picture detected at the step (f32);

5 (f35) finding an I-picture contained in a group containing the Nth picture; and

(f36) decoding pictures from the I-picture found at the step (f35) to the picture detected at the step (f32).

10 8. A repetitive video replay apparatus for use in a video on demand system, comprising:

means for providing bit streams of a video in response to a playback request message, halting to provide the bit streams of the video in response to a playback halt message  
15 and resuming to provide the bit streams of the video in response to a playback resume message;

means for storing constantly a predetermined amount of a latest portion of the bit streams during the playback of the video;

20 means for decoding the bit streams from the bit streams providing means in response to a user's command for playback of the video and decoding the bit streams stored in the storing means in response to a user's command for repetitive replay of the latest portion of the video;

25 means for displaying the bit streams decoded at the decoding means;

means for providing the playback request message to the bit streams providing means in response to the user's command for playback of the video, the playback halt message to the bit streams providing means in response to the user's command 5 for repetitive replay of the latest portion of the video and playback resume message to the bit streams providing means when repetition of the latest portion of the video ends; and means for providing an interface between the bit streams providing means and the other means of the repetitive video 10 replay apparatus except for the bit stream providing means.

9. The apparatus as recited in claim 8, wherein the storing means is a FIFO memory for pushing out a bit of the stored bit streams and storing a next bit of the bit streams when the 15 FIFO memory becomes full, the bit which is pushed out having been stored in the storing means for a longer time than any other bit of the bit streams.

10. The apparatus as recited in claim 9, wherein the user's 20 command for repetitive replay of the latest portion of the video includes a repetition interval and the number of repetitions.

11. The apparatus as recited in claim 10, wherein the 25 repetition interval represents a time interval from the instance that the user's command for repetitive replay of the

latest portion of the video is inputted.

12. The apparatus as recited in claim 11, wherein the repetition interval is smaller than or equal to a maximum time  
5 interval corresponding to the bit streams of the full capacity of the FIFO memory.

13. The apparatus as recited in claim 12, wherein the decoding means includes:

10 means for retrieving the bit streams from the bit streams providing means in response to the user's command for playback of the video and retrieving the bit streams stored in the storing means in response to the user's command for repetitive replay of the latest portion of the video;

15 means for examining group start codes, picture start codes of each group and picture coding type of each picture in a group by reading the bit streams retrieved by the bit streams retrieving means, in response to the user's command for repetitive replay of the latest portion of the video,  
20 wherein each of the group start codes indicates a beginning of a group having a plurality of pictures, each of the picture start codes indicates a beginning of a picture and each of the picture coding types represents a way in which a picture was coded; and

25 means for detecting a picture that is displayed at the instant that the user's command for repetitive replay of the

latest portion of the video is inputted, in the retrieved bit streams from the storing means

14. The apparatus as recited in claim 13, wherein the  
5 decoding means further includes:

means for calculating the number N of pictures to be decoded, wherein N is a positive integer proportional to the repetition interval;

10 means for searching an Nth picture from the picture detected at the detecting means;

means for finding an I-picture contained in a group containing the Nth picture; and

15 means for decoding pictures from the I-picture found at the I-picture finding means to the picture detected at the picture detecting means.

15. A repetitive video replay apparatus for use in a video on demand system constructed and arranged substantially as herein described with reference to or as shown in figure 1 of  
20 the accompanying drawings.

16. A repetitive video replay method substantially as herein described with reference to or as shown in the accompanying drawings.



# Patent Office

Application No: GB 9808959.2  
Claims searched: 1 to 16

Examiner: John Donaldson  
Date of search: 8 September 1998

## Patents Act 1977 Search Report under Section 17

### Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK CI (Ed.P): H4F(FEHX, FKA, FKX)

Int Cl (Ed.6): H04N 5/00, 5/76, 5/765, 5/775, 5/78, 5/781, 5/782, 5/783, 5/907, 5/91,  
5/93, 7/00, 9/00, 9/79, 9/87

Other: Online:WPI

### Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A, P	GB 2314479 A (NEC), see abstract	-
A	GB 2222742 A (HASHIMOTO), see abstract	-

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